



**STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION**

ROCK PRODUCTS COMMITTEE (RPC)



**Enhanced Quality Control/Quality Assurance Specification
Interim Lessons Learned**

March 1, 2014

QC/QA Specification Project Team
Materials & Quality Assurance Sub-Task Group
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PROJECT INFORMATION

Enhanced Quality Control/Quality Assurance Program for Structural Concrete Sampling and Testing

SUBJECT

Interim assessment of the Department's new Quality Control/Quality Assurance (QC/QA) standard special provision (SSP) for structural concrete materials.

PURPOSE

Provide an overview of the events and recommendations associated with the Department's Structural Concrete Quality Control/Quality Assurance Specification, and develop courses of action that may support its improvement over time.

BACKGROUND

A Decision Document was signed on December 13, 2010, calling for the Department to place clearer requirements for structural concrete quality control into the hands of Contractors (see Appendix A). The Document states that Contractors must have an effective quality control (QC) program that ensures they are achieving the required performance per the Standard Specifications. In turn, the Department must have an effective QA program that does not duplicate the Contractor's QC process, but rather assesses its effectiveness.

The new SSP for "Cast-In-Place Structural Concrete Quality Control" was finalized in 2012, and has been utilized on three projects to date. About six other Department Construction projects are scheduled over the next year that will utilize this new SSP. The new SSP falls under "Section 11-4" in projects using the 2010 Standard Specifications, with the Section titled "*Cast-In-Place Structural Concrete Materials*".

In executing these pilot projects, the Department has encountered a great deal of success and positive feedback from its Industry partners. Several Department stakeholders have also expressed satisfaction with the new program, indicating that the clear specification requirements allow for more efficient quality assurance.

There have also been several learning points along the way, which may result in future improvements to the specification. These points include:

- The need to establish clearer quality decision-making responsibilities for QC inspection staff.
- The consideration for reduced quality control testing frequencies.

- The need for additional DIME familiarization training, and the need to revert to our existing Sample Identification protocol for future QC/QA specification projects.
- The need to reexamine our current process for ensuring jobsite staff receives appropriate ASTM Test Method training and certification.
- Classifying the CTMs that correspond to the ASTMs found within this Section 11-4 Enhanced QC/QA Specification as equivalent, and update the CTMs accordingly.
- Ensuring all projects have access to an American Association of State Highway and Transportation Officials (AASHTO) Accredited Laboratory.
- The finalizing of a Guidance Document for the Office of Structures Construction (OSC), which would allow for additional familiarization training for Department field staff.

DISCUSSION

The Pilot Project initiative for the Department's new Enhanced Quality Control/Quality Assurance program began in the fall of 2012. Since that time, three pilot projects have begun, with additional projects set to begin in spring and summer of 2014. These projects include:

Underway

- 11-2T1824 – Palomar DAR Construction
- 08-0N5904 – Van Winkle Wash Bridge Replacement
- 06-342524 – King's Canyon Expressway project

Scheduled

- 04-235624 – San Francisquito Bridge project
- 03-0F2204 – Sly Park Road uncrossing rehabilitation
- 07-119344 – Citrus Avenue Undercrossing
- 07-215924 – I-5 Widening in Valley View
- 07-215954 – I-5 Widening at Florence
- 07-278304 – I-405 Bridge Rehabilitation/Temple Avenue Overcrossing

Throughout the course of construction of these pilot projects, the Department has initiated several surveys with OSC personnel involved with project delivery and program implementation. The project Structural Materials Representatives (SMRs) from the Office of Structural Materials (OSM) also provided key feedback at the project level in assisting with personnel certification training, as well as the review of Structural Concrete Quality Control Plans (SCQCPs). Feedback from these parties was instrumental in developing this assessment.

Much feedback from Industry was also received at the Pre-Bid Outreach Meetings. This Pre-Bid meeting was included in the specifications for several QC/QA Program Pilot Projects. During the Pre-Bid meeting the Department clarified such items as the applicable bid items for the Section 11-4 SSP, and allowed OSC and OSM personnel to communicate the project's key changes.

One of the key responses on OSC surveys indicated that quality control inspectors were unwilling to certify compliance for several concrete pours, and felt it was their duty to instead

defer the final Contractor certification decision to the Contractor's Quality Control Manager (QCM).

A second comment received included the consideration for reduced QC testing frequencies and requirements. In the survey conducted after one pilot project, as well as at one Pre-Bid Outreach Meeting, Contractor and Department personnel suggested that a minimum testing frequency of 100 cubic yards (CY) for tests such as compressive strength (ASTM C39) and density (ASTM C138) resulted in gaps in visual inspection coverage, and caused an undue use of field resources.

A third note expressed throughout the pilot projects, and also included in one project survey, was the need to conduct additional pre-project familiarization training on the new Data Interchange for Materials Engineering (DIME) Database, as well as sample identification protocols within the Database. The DIME database serves as the single web-based database where all quality control and verification test results are maintained. The link to the DIME database is included in the Section 11-4 SSP, and is found below: <http://www.dot.ca.gov/hq/esc/Translab/DIME/>

During initial project team meetings, it was noted that a move towards certifying all Contractor field and laboratory staff would put a great deal of cost and resource burden onto the Department's Independent Assurance (IA) program. Furthermore, Industry had communicated to the Department in various team meetings that American Concrete Institute (ACI) Field Level I-certified personnel were more readily available and required little upfront training. These reasons, along with ongoing Department policy changes, resulted in the use of national standards for quality control testing. The test methods in the Section 11-4 SSP include the following:

1. Slump – ASTM C143
2. Uniformity – ASTM C143/C143M and ASTM C685, Section A1.10
3. Air content (frequency increases for freeze-thaw areas) – ASTM C231 or ASTM C173
4. Temperature – ASTM C1064
5. Density – ASTM C138
6. Compressive strength – ASTM C39

Because of the use of national standards from AASHTO and ASTM in lieu of California Test Methods (CTMs), the Department took additional efforts to conduct certification training and testing by coordinating with ACI. This was done to ensure that all Department staff were qualified to perform the appropriate testing procedures as part of its own Verification program.

The coordination with ACI presented several logistical challenges, and also created project delivery concerns early on in the program. Despite upwards of 80 slots being made available through Department training contracts, at a cost of approximately \$8,000, the spots could not be filled due to project delivery responsibilities.

It should also be noted that the procedural differences between the ASTM Test Methods referenced in this Enhanced QC/QA Specification and their CTM counterparts are largely negligible.

Many Department labs are in the process of securing AASHTO accreditation, and some Districts had planned to use external accredited laboratories on a temporary basis in the interim. This resulted in some last-minute changes to avoid conflicts of interest, however, due to many of the local laboratories already being involved in Quality Control testing on projects.

Lastly, it has been noted through various discussions that jobsite personnel require some additional specification training. Moreover, some personnel also have not received a full description of the many updates associated with this Enhanced QC/QA program.

ANALYSIS

To provide courses of action and recommendations to support the improvement of the Enhanced QC/QA Specifications, the information collected based on various discussions and surveys with OSC, OSM, and Contractor personnel was studied in detail. This analysis of the lessons learned may help draw conclusions on steps forward and result in future improvements of the specifications.

A first lesson learned garnered from pilot program implementation was the need to establish clearer quality decision-making responsibilities for QC inspection staff on projects. It was not the intent of the specification for quality control inspectors to defer the final Contractor certification decision to the Contractor's Quality Control Manager (QCM). The specification aimed to empower the field testing personnel and field and plant inspection personnel with the ability to certify the quality of concrete in order to place responsibility into the hands of personnel with the most intimate knowledge of jobsite operations. Due to these certification issues, the Department is faced with the following options as listed in Table 1.

Table 1: QC Field Certification

| OPTION | PRO | CON |
|--|---|--|
| Update Section 11-4 SSP to ensure that it includes more direct QC field certification responsibilities | Clarify the specification's intent; Ensure timely and accurate certification | Potential change to Contractor QC operations; Requires a specification change |
| Keep the specifications the same without updating it to include QC field certification language | No specification change is required; Encourages Department involvement in the project | Potential unwillingness to certify compliance; Delayed notification of noncompliant material |

Contractor and Department personnel requested the consideration of reduced quality control testing frequencies, because gaps in visual inspection coverage resulted from the current testing frequencies. It was suggested that the frequency of testing be reduced or, in the case of ASTM C138 Density test method, eliminated entirely to better enable continuous visual inspection. The Department has the two options in considering this request, seen in Table 2.

Table 2: QC Testing Frequencies

| OPTION | PRO | CON |
|--|---|---|
| Reduce the frequency of testing and eliminate ASTM C 138 | Less gaps in visual inspection coverage; Less resource usage | Requires a specification change; Reduction of plastic field testing |
| Keep all the current test methods and frequencies | No specification change is required; Adherence to established testing frequencies | Potential lapses in visual inspection coverage; Resource intensive |

While it should be noted that over 1000 quality control tests have been successfully submitted into DIME as of this report date (see Appendix B, QC/Verification Testing Data From DIME), Department personnel have indicated that a more comprehensive familiarization process may need to take place in the future. There was also a suggestion to revert back to existing Sample Identification protocols, so as to allow for efficient materials management on the DIME Database that leverages preexisting practices. As a result of this response, the Department is faced with the following options as seen in table 3.

Table 3: DIME Familiarization

| OPTION | PRO | CON |
|---|---|--|
| Develop a more comprehensive DIME familiarization process for Department personnel, and revert to existing Sample Identification protocols. | Greater understanding of DIME functionality; Increased usage of DIME by Department personnel; Increased potential for long-term retaining of data | Greater resource usage for the Department; Potential for additional training costs |
| Maintain the established familiarization process | Less resource intensive for the Department; May result in additional Department involvement during project delivery | Less clarity in DIME functionality; Lesser utilization of DIME by Department personnel |

Another lesson learned from the pilot program was the need to examine the personnel certification processes for project field staff. In addition to ACI training fees, there is a significant cost associated with moving Structures Construction Representatives away from their assigned jobsite for two days. The vacancies at the trainings conducted thus far have come as a result of this required time commitment. These factors, combined with project delivery timeline demands, does not warrant the cost associated with the additional ACI Training for all OSC Personnel. The Department's IA Program could be given the ability to certify personnel to the

ASTM test methods, so as to avoid undue training and certification costs. Moving forward, the Department has the following options to consider in Table 4.

Table 4: Certification of Department Field Staff

| OPTION | PRO | CON |
|---|---|---|
| Keep the specifications the same without updating CTMs to refer to corresponding ASTM | Less resource intensive for the Department; Omits the additional cost of ACI trainings for Department personnel | Does not further the Department's goal of aligning with national testing standards; Lack of alignment with Industry |
| Revise CTMs to refer to their corresponding ASTM (for ASTMs noted in this Section 11-4 SSP) | Minimizes confusion; Furthers the Department's goal of aligning with national testing standards | Slight change to Department's current operations; Requires changes to the CTMs |
| Place IA Program in charge of certifying ASTMs for Department staff | Using existing certification systems; Reduced cost | Additional resource usage by the Department; Retraining of IA Certification staff to ASTM test methods |
| Continue to schedule ACI trainings for Department staff certification | Staff would receive ACI Field Level 1 Certification; Receives same certification as Industry | Long-term scheduling costs; Continuous need to coordinate test and class sessions with ACI |

Another lesson learned was the need to secure the services of an AASHTO-accredited verification laboratory well in advance of the project start date. Ensuring early availability of an AASHTO-accredited laboratory could help avoid undue delays, and could help ensure lab testing work proceeds in accordance with the specification.

The completion and distribution of the Enhanced QC/QA Construction Guidance Document to OSC Staff in a training setting may better clarify the requirements of this specification, and also ensure that future project priorities are better aligned.

CONCLUSION

This document has been produced in an effort to capture the lessons learned from ongoing Enhanced Quality Control/Quality Assurance Program pilot projects. The conclusions drawn from these observations will support the continuing program improvement. Analysis of the various lessons learned has led to the following conclusions:

1. Based on results submitted into DIME, there have been no Contractor QC testing failures recorded for the ongoing pilot projects. However, analysis indicates that the Section 11-4 SSP needs minor revisions to clarify the specification's intent and ensure that it includes direct QC field certification responsibilities. Department personnel can address potential changes to Contractor's QC operations by clarifying the QC Inspector's role during the pre-concrete meeting.
2. Current QC testing frequencies have caused lapses in visual inspection coverage. In analyzing these lapses, a revision to the specification may be necessary to reduce these QC testing frequencies and omit ASTM C 138 Density. The performance of QC tests such as compressive strength and air content, as well as the submittal of mix designs, offsets the need for additional density testing.
3. Quality Control testing laboratories and personnel appear to be utilizing DIME as required per the Contract Specifications (see Appendix B - QC/Verification Testing Data From DIME). The analysis also indicates that additional DIME familiarization training is required for Department field personnel, along with the reinforcement of existing Sample Identification protocols. This additional upfront investment for training will yield greater long-term cost savings for the Department.
4. The two-day ACI Field Level I Certification trainings for Department field staff have posed project schedule and cost concerns, leading to vacancies at recent training courses. Placing the IA Program in charge of certifying to ASTMs would reduce cost concerns and allow the Department to use the existing certification systems. Additionally, revising the CTMs to refer to their corresponding ASTMs will minimize potential confusion. The long-term benefits and cost savings associated with these courses of action outweigh the utility of ACI Field Level 1 certifications.
5. To avoid conflicts of interest and accreditation issues, the availability of AASHTO-accredited verification laboratories should be determined well in advance of the project start date.
6. Based on the analysis, using the Enhanced QC/QA Construction Guidance Document as a training tool will clarify the specification's requirements for Department field staff.

RECOMMENDATIONS

It is recommended to retain the Enhanced QC/QA Specification largely as it is; the specification is satisfactory and believed to be meeting the intent of the Decision Document. However, based on the factors included above, it is recommended that the Department's Rock Products Committee, or other appropriate channels, reexamine the requirements of the new Enhanced QC/QA Specification.

Minor updates to the specification should maximize resources, while also taking into account the need to assure quality under the Department's specifications and CFR requirements.

The recommended program updates, based on various discussions and surveys with OSC, OSM, and Contractor personnel, include the following:

- Establish clearer quality decision-making responsibilities for QC inspection staff.
- Reduce QC testing frequencies and remove the ASTM C138 requirement to encourage more frequent visual inspection.
- Provide additional DIME familiarization training for all project staff and Contractor personnel.
- Revert to existing Sample Identification protocol.
- Rewrite CTMs to refer to the ASTMs found within Section 11-4.
- Use the Department's IA Program to certify CT Staff to these revised CTMs.
- Ensure all projects have access to an AASHTO accredited verification laboratory that is absent of conflicts of interest.
- Finalize a Guidance Document for the Office of Structures Construction (OSC).

Please contact Keith Hoffman at (916) 227-7263 for any questions regarding this matter.

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APPENDICIES:

Appendix A – Signed Decision Document (Attached)

Appendix B – QC/Verification Testing Data From DIME as of February 2014

Appendix B – QC/Verification Testing Data From DIME as of February 2014